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IMPROVED FERTILISERS

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Applied

(57) Claim

1. A fertiliser for application to a substrate including fine particles of calcium carbonate characterised in that said calcium carbonate particles are precipitates, and in that the fertiliser contains a suspension agent, said fertiliser optionally also including according to substrate requirements any one or more of the following ingredients: calcium bicarbonate, precipitates of magnesium carbonate, sodium carbonate, potassium carbonate and/or sulphur; medicaments, insecticides, herbicides, insoluble hormones, antifungal agents, carbohydrates and trace elements.

2. The fertiliser of claim 1 wherein the suspension agent, is a carbohydrate that gels when contacting cations having a charge greater than plus 1.

Make limestone pure / fine
Raw material not pure enough to be
useful to make it yourself.
To change amount of said / gypsum element
do this.

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**ORIGINAL**

**COMPLETE SPECIFICATION**

**PETTY PATENT**

Invention Title: IMPROVED FERTILISERS

Name of Applicant: Gavin Frank MURDOCH

The following statement is a full description of this invention, including the best method of performing it known to me/us:

**Improved Fertilisers**

## TECHNICAL FIELD

This invention relates to improved fertilisers. More particularly, it relates to improved lime fertilisers for application to pasture and any crop. However, this potential application is given by way of example only, and it will be appreciated that it is not intended to be limiting.

## BACKGROUND ART

Acidic soil results when calcium and magnesium levels in the soil are depleted, and is considered problematic by farmers growing pasture, and other crop growers such as orchardists. Under acid conditions, the availability of nutrients to plants is lessened. An ideal soil pH level is 6.5. Crop growers such as farmers and orchardists have to date expended a considerable amount of time and resources to decreasing soil acidity. Hill country is particularly prone to drops in pH and correcting this can be a logistically and financially onerous task.

A conventional method of decreasing soil acidity (ie increasing pH) is to apply commercially available lime fertiliser. Commercial lime fertiliser is calcium carbonate rock that has been mined and is then mechanically ground to large particles, gravelly in appearance and texture. Commercial lime fertilisers may contain impurities to a level of approximately 35% depending on the deposit mined. The commercial lime fertilisers must be carted to the areas of application, and physically spread over the soil, requiring significant expenditure on distribution methods such as top dressing. A purpose of the application of commercial lime fertilisers is to replace calcium depleted from the soil,

thereby restoring pH (lessening acidity) and optimising nutrient uptake by pasture, crop or other plants grown in the soil or other medium eg hydroponics. However, commercial lime fertilisers d not replace magnesium, or other deficient nutrients.

Clearly with the range of impurities being approximately 35%, commercial lime fertiliser frequently may comprise only a moderate content of pure calcium carbonate. Much of the fertiliser may accordingly exert little treatment effect on the substrate.

Another disadvantage with presently available lime fertilisers is that, due to the coarse granular particulate size to which the mined lime is ground, the lime particles are only very slightly soluble in water. It is estimated the solubility of commercial lime in water is approximately 1:2000 parts water.

When applying commercial lime to a substrate, a significant volume of water is accordingly required to dissolve the lime particles. However, rainfall exacerbates fertiliser losses through surface run-off. Commercial lime also exhibits very slow release into the substrate because of the particle size and resulting low solubility. A substantial proportion of the commercial lime particles, due to their size and impurities with moderate rain harden and remain undissolved and consequently the farmer obtains less than ideal results in increasing pH using commercial lime.

Being applied in particulate form, losses of fertiliser in windy conditions may be significant.

The cost of transporting commercial lime with the higher percentage of impurities is high.

It would be desirable to provide a more effectiv lime fertiliser exhibiting rapid and ffective results in increasing soil pH. It would also be desirabl to provid a lime fertiliser that contains calcium carbonate or calcium carbonate and magnesium carbonate and/or sulphur precipitate or other soil depleted nutrients, which is less labour intensive and expensive for a farmer or crop grower to prepare, transport and apply.

It is an object of the present invention to address the foregoing problems or at least to provide the public with a useful choice.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

## DISCLOSURE OF INVENTION

According to one aspect of the present invention there is provided an improved fertiliser including fine particles of substantially pure calcium carbonate, characterised in that said calcium carbonate particles are precipitates. Calcium carbonate precipitate is of powdery appearance and texture is microcrystalline.

According to another aspect of the present invention there is provided an improved fertiliser substantially as described above whereby a suspension agent may also be included.

In a preferred embodiment said suspension agent may be any carbohydrate which causes thickening when contacting cations having a charge greater than plus one, such as starch. However, it will be appreciated that any other thickening or gelling agent is within the scope of the present invention. For example, gels can form with many

carbohydrates oxidised with acid and neutralised with sodium, potassium or ammonium alkalis. The salts of such alkalis are soluble in water, and gel with lime precipitate, thereby producing calcium cations.

According to another aspect of the present invention there is provided an improved fertiliser substantially as described above wherein there may further be included other user selected ingredients.

The optionally added ingredient may have any one or more of the following functions: assisting plant growth, assisting the development of micro organisms within the soil, providing treatment to increase soil health, plant health and health of animals that may feed on that crop or pasture.

One preferred optional ingredient may be calcium bicarbonate, which is more soluble than calcium carbonate and immediately releases calcium ions to the soil and raises the pH. Another preferred ingredient may be a soluble calcium salt (made from calcium and glucose) which is soluble as a complex, having the same calcium-releasing effect.

Such optional ingredients may be soluble or insoluble. Examples of insoluble additives are medications, weedicides, insecticides, herbicides and insoluble hormones.

Soluble chemicals that will not react with other fertiliser ingredients whilst in particulate form may also be included. Examples are soluble chemicals, such as medicants, and anti-fungal agents.

Further additional ingredients may comprise starch and glucose, which are carbohydrates and provide food for micro organisms and plants as well as animals. These carbohydrates may be mono, di-or

polysaccharid s. Starch and glucose oxidise to gluconic acid which, in the presence of calcium ions, hydrolyses to calcium gluconate. Calcium gluconate has a pH of 7 and is highly soluble (1:30) in water.

Further ingredients that may optionally be added to the improved fertiliser are complexes or chelates. Any cations of a charge [cation]$^{2+}$ or more must be included in the fertiliser in this form. The addition of complexes or chelates may supply trace elements to the soil without enabling their inter-reaction in the fertiliser with other ingredients, or with other soil components, thereby supplying a more balanced nutrient intake to the pasture or crop grown on that soil. Examples of chelates that may be particularly suitable are salts of ethylene diaminotetraacetic acid with magnesium, cobalt, selenium, zinc, manganese, molybdenum and iron.

According to another aspect of the present invention there is provided a method of manufacturing an improved fertiliser including substantially pure calcium carbonate comprising the steps of

(a) preparing an aqueous solution of calcium chloride and sodium carbonate and permitting the double decomposition of same,

(b) extracting the resulting calcium carbonate precipitate and

(c) drying same.

The drying step may be for a period of four hours at 200°C, however any other appropriate drying regime is within the scope of the present invention.

The density and fineness of the precipitated calcium carbonate may be varied according to the strength of the aqueous solution prepared - a light

form of lime precipitate being obtained from a more dilute solution and conversely a denser, less fine calcium carbonate precipitate obtained from a more concentrated solution.

According to another aspect of the present invention there is provided a method of a treating substrate comprising the steps of:

(a) providing a quantity of precipitated calcium carbonate,

(b) optionally adding additional ingredients to the precipitated calcium carbonate according to the user's requirements,

(c) adding a liquid to the above ingredients to produce a mixture,

(d) agitating the mixture to produce a suspension of the calcium carbonate precipitate (and optional ingredients) in the liquid, and

(e) applying the suspension to the substrate.

In a preferred embodiment the liquid may be water. Alternatively, any other suitable diluent may be used, eg. whey or other liquid by-products.

In a preferred embodiment the ratio of the mixture of precipitate to water is 1:5 w/v when applying from aircraft. Alternatively, as much water may be used as required to suspend the precipitated calcium carbonate when applying by ground applicators. It is desirable that the suspension is constantly being circulated during application.

In a preferred embodiment of the above treatment method the dosage of suspension to be applied to the substrate may be substantially 6.25 kgs to 1 hectare of land to raise pH by 0.1, 12.5 Kg to raise pH by 0.2, 25 Kg to raise pH by 0.3-0.4, 50 Kg to raise pH by 0.8-1.0 approximately. However, any other effective dosage rate is within the scope of the present invention. The suspension shall hereinafter be referred to as fertiliser.

In a preferred embodiment additional ingredients may be light or heavy magnesium carbonate precipitate when magnesium nutrient levels are low in the soil, or sulphur precipitate when sulphur nutrient levels are low. These examples are not intended to be limiting and ingredients may be added as appropriate to soil profile.

The fertiliser (containing calcium carbonate precipitate as claimed in the present invention) is able to quickly increase substrate pH, even when only a small amount of fertiliser is applied. The fertiliser is also able to correct calcium and magnesium levels. Additional sulphur may also be added to the fertiliser if the soil is considered to be very deficient in sulphur.

As the fertiliser contains materials in a precipitated or a fine particulate form the size of the materials is ex :mely fine, and in fact some thousands times smaller than the constituent particle size of commercial lime fertilisers. The extremely small size of the precipitated particles of the lime fertiliser of the present invention permits, when applied with water and forming a suspension, a minimal loss of the fertiliser, immediate action, a smaller amount of fertiliser having to be applied, and a long lasting activity and retention within the soil. Clearly the greater surface area of the fine particles presents a greater surface area ratio and thus enhanced solubility in comparison to larger particles.

The calcium carbonate precipitate is formed into a suspension in water - a small proportion of the calcium carbonate precipitate dissolves in the water and is therefore able to begin its antacid action immediately upon application. The addition of a gelling or suspending agent further permits the fertiliser to stick to the foliage and the ground and is however able to be washed off the foliage and penetrate the soil when it rains. A

proportion of th precipitate in the suspension dissolves and is absorbed in the soil at the level below th surface. Th calcium carbonate precipitate accordingly works initially n the top inch or so of the soil and after a period transfers some of the material further down eg after three months having penetrated two inches down and after a further three months to the third inch of soil. The precipitate remains active as an antacid until the quantity have been used up. It will be appreciated that the length of activity of the precipitate will depend on the rainfall and may as a general rule be inactive only after some two or more years.

## BEST MODES FOR CARRYING OUT THE INVENTION

### Example 1

200 grams of calcium carbonate precipitate was made into a suspension with one litre of water. The suspension was applied to one cubic metre of soil with a pH of 5.5. Testing showed that at a soil depth of 4 centimetres, pH of the soil had been raised to pH 6. This eq· ates to a rate of application of 8 kgs per hectare, if the calcium carbonate precipitate is used without other ingredients.

The application of 6.25 kgs to the hectare applied as a suspension at a concentration of 1 kg calcium carbonate precipitate to 5 litres of water is equivalent to one tonne of commercial lime.

Starch and glucose, as a member of the carbohydrate family are food for micro-organisms and plants as well as animals so that any of the carbohydrate family whether mono, di, or poly saccharides is important as a food and may be added to the calcium carbonate precipitated material when being applied to soils, crops and pastures.

Insoluble and s lubl classes of medications can also be added to the calcium carbonate precipitate for purposes of control of pests, weeds, fungus infections, and hormonal control. The insoluble medications will be suspended whilst the water added on application of the calcium carbonate precipitate suspension will allow the dissolving of the soluble medication added.

**Example 2(a)**

| | |
|---|---|
| Calcium Carbonate precipitated powder | 87% |
| Starch powder | 5% |
| Glucose powder | 8% |

The above ingredients were mixed with water at a ratio of 1 kg in 5 litres of water which produced a suspension which remained suspended for two hours (giving ample time to apply to pasture or crops or any plants growing in the soil).

This mixture, when applied to pasture at the rate of 5 kg to the hectare, changed the pH from 5.5 to 5.7 in seven days. After rainfall of a moderate amount and 14 days the pH rose to 5.9.

**Example 2(b)**

The same mixture applied to pasture at the rate of 10 kg to the hectare changed the pH from 5.5 to 5.8 in seven days. After rainfall of a moderate amount and 14 days the pH rose to 6.0.

In both these trials the pasture gave more substantial growth. The green colour of the pasture deepened when compared with the control which had no application of the mixture.

**Example 3**

Calcium carbonate precipitate when suspended in water with a mixture of chelated trace elements produced f liage demonstrating remarkably more growth and deep green colouration. Soil and foliage tests showed increases in all levels of trace elements of calcium. The foliage also showed higher levels of phosphorus, potassium nitrogen and sulphur when compared with the control area. It is considered the pH increase allows increased up-take of nutrients which with the lower pH was not possible.

This invention is not limited to the proportions from this example for, depending upon requirements, combinations of all additives may change where from sol analysis other deficient nutrients may be added as precipitated material or soluble or insoluble nutrients and applied with water. Carbohydrates other than starch may alternatively be used for glucose and be substituted for another carbohydrate of the mono, di- or poly saccharide families.

**Example 4**

Another example was tested using a salt of d-manuronic acid salt of sodium as the suspending agent:-

| | |
|---|---|
| Calcium carbonate precipitate | 94.00% |
| d-manuronic acid sodium salt | 1.00% |
| Sucrose | 5.00% |

The powder of the above formula was mixed with water to produce a suspension of the calcium carbonate precipitate. As previously

discussed, suspension of the precipitate in water releases calcium ions, allowing the suspending agent to gel and thicken the suspension. The suspending agent held the particles in the suspension with no separati n for four hours, and the sucrose dissolved in the water.

1 kg to 15 litres of water was applied to 1 hectare at the rate of 5 kg per hectare. The pH changed in seven days from 5.5 to 5.7. After rainfall of a modera'e amount and 14 days later the pH rose to 5.9.

**Example 5**

Calcium carbonate precipitate fertiliser was applied to farmland at a level of 12.5 kgs per hectare. The pH prior to application was 5.5. After two months the pH at a soil level of 1 inch under was 6.9, at 2 inches under was 6.3 and at 3 inches under was 5.6.

**Example 6**

Calcium carbonate precipitate fertiliser was applied to a farm at a level of 12.5 kgs per hectare. Testing on soil nutrient levels and pH was conducted prior to the application (Table A), and three months after application (Table B). The results as shown below in Table A and Table B demonstrate that potassium, calcium, magnesium, sulphur and sodium levels had all increased, while phosphate levels remained stable. In the three month period, the pH had increased from 5.5 to 5.8.

**Table A** Soil Nutri nt & pH Levels prior t Application of Calcium Carbonate Precipitate Fertiliser

| Analysis | Level Found | Normal Range | Nutrient Status | | |
|---|---|---|---|---|---|
| | | | Low | Medium | High |
| pH | 5.5 | 5.8 - 6.5 | — | | |
| Phosphorus (µg/ml) | 32 | 20 - 30 | — | — | — |
| Potassium (me/100 g) | .38 | .50 - .80 | — | | |
| Calcium (me/100 g) | 4.4 | 6.0 - 12.0 | — | | |
| Magnesium (me/100 g) | .56 | 1.00 - 3.00 | — | | |
| Sodium (me/100 g) | .13 | .20 - .50 | — | | |
| C E C (me/100 g) | 22.0 | 12.0 - 25.0 | — | — | |
| Base Saturation (%) | 24 | 50 - 85 | — | | |
| Bulk Density (g/ml) | .65 | 0.60 - 1.00 | — | — | |
| P Retention (%) | 87 | 30 - 60 | — | — | — |
| Sulphate-S (µg/g) | 10 | 10 - 20 | — | — | |

**Table B** Soil Nutrient and pH Levels Three Months after Applicati n f Calcium Carbonate Precipitate Fertiliser

| Analysis | Level Found | Normal Range | Nutrient Status | | |
|---|---|---|---|---|---|
| | | | Low | Medium | High |
| pH | 5.8 | 5.8 - 6.5 | | | |
| Phosphorus (µg/ml) | 32 | 20 - 30 | | | |
| Potassium (me/100 g) | .87 | .50 - .80 | | | |
| Calcium (me/100 g) | 8.0 | 6.0 - 12.0 | | | |
| Magnesium (me/100 g) | 1.74 | 1.00 - 3.00 | | | |
| Sodium (me/100 g) | .23 | .20 - .50 | | | |
| C E C (me/100 g) | 31.0 | 12.0 - 25.0 | | | |
| Base Saturation (%) | 35 | 50 - 85 | | | |
| Bulk Density (g/ml) | .53 | 0.60 - 1.00 | | | |
| P Retention (%) | 87 | 30 - 60 | | | |
| Sulphate-S (µg/g) | 15 | 10 - 20 | | | |

It can be seen that the calcium carbonate fertiliser of the present invention comprises a precipitated calcium carbonate which has particles orders of magnitude smaller than conventional ground calcium carbonate particles, and is furthermore a substantially pure calcium carbonate product. Because of the high surface area to volume ratio, the

precipitated calcium carbonate particles have high solubility and the antacid action is thereby able to begin immediately upon contacting soil. Because of the composition of the fertiliser of the present invention, additional nutrient supplements or therapeutic agents for soil, crop or animals may be incorporated into the powder. As the fertiliser of the present invention is applied as a suspension, losses from wind drift are thereby obviated and furthermore because of the geiling agent, the fertiliser suspension adheres to the foliage and ground and is washed straight into the soil during rainfall. In contrast, commercial calcium carbonate ground fertilisers have lesser solubility and are spread as a solid giving losses from wind drift and surface run off. Further, the particles can become cement-like and thereby remain in the soil unable to be used.

Because it is in suspension the fertiliser of the present invention is able to have ingredients such as 2, 4D mixed in with it and be applied at the same time thereby saving double application costs. Clearly, this is not achievable with conventional commercial calcium carbonate fertilisers. Of course, additional nutrients such as sulphur and other trace elements can be added to the blend of the present invention where considered appropriate.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope thereof as defined in the appended claims.

It will be clearly understood that for the purposes of this specification the words "comprises" and "comprising" are to be understood to mean "includes but is not limited to" and "including but not limited to" respectively.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A fertiliser for application to a substrate including fine particles of calcium carbonate characterised in that said calcium carbonate particles are precipitates, and in that the fertiliser contains a suspension agent, said fertiliser optionally also including according to substrate requirements any one or more of the following ingredients: calcium bicarbonate, precipitates of magnesium carbonate, sodium carbonate, potassium carbonate and/or sulphur; medicaments, insecticides, herbicides, insoluble hormones, antifungal agents, carbohydrates and trace elements.

2. The fertiliser of claim 1 wherein the suspension agent, is a carbohydrate that gels when contacting cations having a charge greater than plus 1.

3. A method of preparing the fertiliser of claim 1 or 2 for application to a substrate comprising the steps of:

(a) preparing an aqueous solution of calcium chloride and sodium carbonate and permitting the double decomposition of the solution,

(b) extracting the resulting calcium carbonate precipitate,

(c) drying the calcium carbonate precipitate,

(d) optionally adding any one or more of the ingredients listed in claims 1 and 2,

(e) adding a liquid to the ingredients to produce a mixture,

(f) agitating the mixture to produce a suspension,

(g) applying the suspension to a substrate.

Dated this 23rd day of March 1998

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